Chapter 10

Environmental Health and Safety

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10.1 Primary Issues

This chapter evaluates environmental health issues related to arsenic, cadmium, and lead. These metals are present in surface soils at the site due to deposition from airborne arsenic from past smelter operations in Ruston.

The primary issues analyzed in this chapter are:

- Would mining remobilize the existing arsenic in the site topsoils as air contamination and dust?
- Would mining remobilize the existing arsenic in the site topsoils as surface water contamination?
- Would arsenic be present in soils to be sold and exported from the site?
- Would arsenic enter groundwater as a result of the proposal?
- Would tug propeller wash stir up contaminated sediments and harm endangered fish species or other marine life?

10.2 Affected Environment

10.2.1 Background

The Glacier Northwest site is located approximately 5 air miles from the now-closed ASARCO smelter. During the operation of this smelter, from approximately 1890 to 1985, fallout containing arsenic, cadmium, lead, and other contaminants was distributed to surrounding areas, including Maury Island and the Glacier Northwest site.

The ASARCO smelter facility and the immediate vicinity have been designated an EPA Superfund site (this designation did not encompass the Vashon/Maury Island area). Site closure and remedial measures are well underway at both the smelter site and the neighborhoods surrounding the smelter.

A series of studies has been performed to evaluate the distribution and exposure pathways of contamination left as a result of the smelter operation. For the Vashon/Maury Island area, the defining document has been the Ruston/Vashon Arsenic Exposure Pathways Study (University of Washington 1987) (referred to as “the Pathways Study” in this chapter). The Seattle-King County Health Department is currently reviewing the analysis of a new set of soil samples obtained form Vashon/Maury Island and preliminary results were released in April 2000.

Additional studies and background information used for the FEIS analysis include:

- The Potential Water Quality Impacts and Mitigations report (AESI 1998b) and the Soils, Geology, Geologic Hazards, and Groundwater Report (AESI 1998a), both prepared for the environmental checklist; both reports are available at the Vashon Community Library;

- preliminary results of a study of arsenic and lead contamination on Maury/Vashon Islands by King County Public Health (2000);

- an addendum report on groundwater that includes additional groundwater testing from new monitoring wells installed for the EIS analysis (AESI 1999); this report is also available at the Vashon Community Library;

- an additional evaluation of onsite arsenic, including new testing completed for the EIS by Terra Associates in 1999; the memorandum reporting Terra’s findings was included in Appendix B of the DEIS; and

- a memo prepared by Terra Associates summarizing the results of all groundwater monitoring performed on the site by AESI (Appendix E of the DEIS with Addendum in the FEIS).

The results of these studies are described in the following section.

10.2.2 Existing Contaminant Distribution

Based on direct testing on the project site, and on previous studies (as cited in text), approximately the top 18 inches of soils at the site contain arsenic, lead, or cadmium in concentrations above natural levels (Table 10-1 and Figure 10-1). This is not surprising since the material arrived at the site through aerial fallout from the ASARCO smelter, leaving what is called a “mantle” of contaminants on the surface.

Arsenic, lead, and cadmium are evaluated in this EIS. Levels of these three metals above MTCA residential cleanup values have been identified in the near-surface soils at the site. Other metals were also present in the plume, but the results of studies both at Ruston and at the Everett Smelter site indicate that these three metals are the best indicator for the plume. Moreover, lead and cadmium levels correspond with elevated arsenic levels. Therefore, the following discussion will focus on arsenic and lead, which will be used as indicators for contamination resulting from the smelter emissions. Wherever arsenic levels on the site are below MTCA Method A Residential levels, the other two metals are also present in concentrations below the applicable cleanup level.

Much of the surface soil at the site contains arsenic and lead levels well above what would be expected to occur naturally. Natural levels of arsenic in western Washington range from 1 to 7 ppm (Ecology 1994), while studies conducted for this EIS found levels of arsenic in project site topsoils ranging from 6 to 330 ppm (see Appendix B of the DEIS). Studies conducted by Landau Associates (1999) and AESI (1998b) also found elevated levels of arsenic in the topsoils at the site. The highest level of arsenic found to date on the site is 477 ppm in a surface sample (Sample GM-8, reported by AGRA). Natural levels of lead in western Washington range from 5 to 30 ppm. The levels of lead found in the surface soils on the site ranged from less than 5 ppm up to 840 ppm. The elevated levels of lead correspond to areas where the arsenic levels were also elevated with respect to background or natural levels of theses two metals. Elevated arsenic levels occur throughout Vashon and Maury Island, as documented in the Pathways Study, which found levels ranging from 2 to 290 ppm (University of Washington 1987), and by King County (King County Public Health 2000).

The Pathways Study focused on human exposure, with soil sampling concentrated in areas where children would be exposed to near-surface soils. The sampled areas included homes, schools, and playgrounds. No testing was done in the forested areas of the Islands. As such, the levels of arsenic in tested areas were diluted by cultural activities, such as lawn mowing, tilling, and earth grading activities.

Supplemental soil sampling and analytical testing was conducted by Foster Wheeler (Appendix C of the DEIS). The Foster Wheeler testing showed a peak lead value of 840 ppm in a surface sample. The highest level found in samples collected by Terra was 830 ppm. Testing by Foster Wheeler also showed a surface sample with a cadmium level of 9.8 ppm. The highest cadmium level in samples collected by Terra was 9.3 ppm. These variations are not significant, and the results of the supplemental site sampling is consistent with the testing done by Terra Associates. [Note: Table 3 in Appendix C of the DEIS contained typographical errors for three entries: surface arsenic concentrations for Samples 10 and 11, and surface lead concentration for Sample 12. The correct values are: Sample 10, surface, arsenic: 4.3; Sample 11, surface, arsenic: 1.9; Sample 12, surface, lead, 5.8. The correct data for Table 3 of Appendix C in the DEIS is included with the FEIS as an erratum to Appendix C.]

The amount of arsenic within some topsoils at the site exceeds cleanup levels established by the EPA for the ASARCO cleanup in Ruston and North Tacoma, as well as industrial and residential cleanup levels defined in the MTCA. During the EPA evaluation and cleanup of the area nearest the ASARCO smelter, within the Ruston/North Tacoma study areas, EPA set an "action" level at 230 ppm for arsenic. The action level was that concentration at or above which required removal or containment of contaminated soils to protect human health. Under the MTCA, the limit for arsenic is 20 ppm in residential areas and 200 ppm for industrial areas. Since the project site is zoned and managed as a mining site, it falls under the industrial area classification of the MTCA. However materials to be mined from the site would need to meet residential cleanup standards. Hence the remedial action will need to clean up site soils to meet MTCA residential cleanup standards.

In contrast to the contaminant concentrations found in surface soils, subsurface sand and gravel deposits on the site (the material that would be exported from the site) contain natural levels of arsenic, lead, and cadmium, based on direct testing of these materials. "Natural" levels are those that occur naturally throughout the Puget Sound region. As shown in Table 10-2, none of the subsurface samples analyzed contained elevated levels of these contaminants (sample locations shown in Figure 10-2).

Likewise, levels of these contaminants in groundwater at the site and throughout Vashon/Maury Islands are also within natural levels, based on the direct testing done at the site and on previous testing conducted by the University of Washington (1987) and others. The ambient levels of arsenic in the advance sand aquifer in the vicinity of Naval Submarine Base Bangor were found to be less than 1 μg/l for the 50th percentile value (average value range) and 4 μg/l for the 90th percentile value (upper range of the ambient water quality) (Greene 1997). The geologic conditions beneath Maury Island are similar to the geologic conditions in the area covered by the Greene report in Kitsap County. Testing conducted by AESI (1999) found arsenic levels in groundwater on the project site to range between 0.002 and 0.004 ppm (the MTCA groundwater cleanup level is 0.005 ppm). Tests conducted for the Pathways Study identified levels at less than 0.010 ppm. Prior groundwater testing summarized by Carr and Associates (1983) and Vashon-Maury Island Groundwater Advisory Committee (1998) also found groundwater levels of arsenic, lead, and cadmium to be within natural limits on Vashon and Maury Islands.

Surface water on the site is essentially absent, so none is contaminated. Rain tends to percolate rapidly into the porous sand and gravel deposits at the site. Some drainage was observed along roadsides during heavier rainfall events. The areas that generate runoff are disturbed areas that have been found to have arsenic at naturally occurring background levels. Thus, runoff from roadways and disturbed areas would not be exposed to elevated arsenic. Overall there is no significant surface water on the site and, therefore, no contaminated surface water is present.

10.3 Impacts

10.3.1 Would mining remobilize the existing arsenic in the site topsoils as air contamination and dust?

10.3.1.1 Proposed Action

The Applicant proposes to excavate materials that have been exposed to arsenic fallout from 1890 to 1995. Since falling on the site, the arsenic has remained relatively stationary in a shallow “mantle” over the site, being concentrated in the uppermost levels of the topsoils and declining with depth, with little arsenic present below 18 inches. The arsenic has chemically bound to organic materials in the topsoil, and does not easily wash out of the soil with water.

In its current state, the arsenic poses relatively little danger to anyone off the site, since it is essentially trapped in firm soils contained by roots. The primary risk would be to people using the site, with direct contact with contaminated soils being the biggest concern.

However, with continued mining at the site, these soils would be excavated, removed, and contained each time a previously undisturbed area is prepared for mining. The Applicant proposes to segregate and isolate the impacted topsoils as a Voluntary Cleanup Action under MTCA. A Cleanup Action Plan would be developed that would include a soils management plan. During this containment process, contaminated materials would be in contact with the air and, therefore, vulnerable to being blown away as dust. Chapter 3 describes how the operator would be required to prepare a dust control plan in consultation with the Puget Sound Clean Air Agency. However, because of concerns regarding arsenic, additional measures must be taken to address potential impacts from dust generated from contaminated soils. These measures are described in Section 10.4, and include covering exposed materials and limiting soil clearing operations to 2-acre parcels at any one time.

With these mitigation measures in place, significant risks to the environment or human health would be effectively mitigated.

10.3.1.2 Alternatives 1 and 2

The risk of arsenic becoming airborne would be effectively mitigated under either of the action alternatives for the same reasons stated for the Proposed Action.

10.3.1.3 No-Action

No impact would occur even though limited mining would continue under No-Action. The Applicant would still be required to manage soils at the site according to measures prescribed by Ecology, since this issue has been brought to the attention of the Applicant, the public, and Ecology.

10.3.2 Would mining remobilize the existing arsenic in the site topsoils as surface water contamination?

10.3.2.1 Proposed Action

Because there are no streams or other surface waters on the site, arsenic or other contaminants cannot travel offsite via surface water flows.

In addition, direct laboratory testing of arsenic-containing soils from the site has demonstrated that arsenic at the site is in a stable form, being bound tightly to surface soils. Leachability analyses (the ability of a material to be washed down through soils with rainwater) of soils containing the highest concentrations showed that arsenic deposits in soils at the site are resistant to leaching (see Appendix B of the DEIS). The fact that sampling also showed that arsenic has remained within the top 18 inches of soils further demonstrates that the arsenic is not very leachable.

Finally, the Applicant is proposing to contain contaminated soils (see Appendix C of the DEIS). With such containment, the end result of the project would include remediation of the site, with arsenic being contained rather than mobilized.

10.3.2.2 Alternatives 1 and 2

Arsenic would not enter the surface waters under either of the action alternatives for the same reasons stated for the Proposed Action.

10.3.2.3 No-Action

Under No-Action, limited mining would continue, but again, for the reasons already stated, arsenic would not enter surface waters.

10.3.3 Would arsenic be present in soils to be sold and exported from the site?

10.3.3.1 Proposed Action

Under the Proposed Action, contaminated soils would be segregated from materials to be exported. Sampling has demonstrated that the sands and gravels proposed for export from the site have only naturally occurring levels of arsenic, cadmium, and lead. Contaminated materials would be contained onsite, as described in Section 10.4.

10.3.3.2 Alternatives 1 and 2

Arsenic would not be exported from the site under either of the action alternatives for the same reasons stated for the Proposed Action.

10.3.3.3 No-Action

Under No-Action, limited mining would continue, but again, for the reasons already stated, arsenic would not be transferred offsite.

10.3.4 Would arsenic enter groundwater as a result of the proposal?

10.3.4.1 Proposed Action

Mining at the site, as proposed, would not result in arsenic entering the groundwater. The primary fact that leads to this conclusion is that arsenic is tightly bound to topsoils at the site. Arsenic has not entered the groundwater or subsurface sand and gravel deposits since arsenic first drifted onto the site from the ASARCO smelter more than 70 years ago. Testing of groundwater conducted by Carr and Associates, Geraghty and Miller, and AESI, and tests of the Gold Beach water supplies, show that groundwater levels of arsenic are within natural levels on Vashon/Maury Islands.

The Applicant is proposing to completely contain contaminated soils onsite, using a lined and covered containment cell, as described in Section 10.4 and in Appendix C of the DEIS.

10.3.4.2 Alternatives 1 and 2

Arsenic would not enter groundwater under either of the action alternatives for the same reasons stated for the Proposed Action.

10.3.4.3 No-Action

As with the Proposed Action, no impacts on groundwater are expected. While mining activity is assumed to be much lower under No-Action, the Applicant would still need to resolve the issue of the impacted soils during mining.

10.3.5 Would tug propeller wash stir up contaminated sediments and harm endangered fish species or other marine life?

10.3.5.1 Proposed Action

Residents in the area raised this question during public scoping. The likelihood of this occurring is negligible for several reasons.

First, the deposition of arsenic through water is not nearly as direct as that through air. Arsenic deposited on the waters of Puget Sound was greatly diluted and dispersed by wave action and currents.

Second, the sands and sediments themselves are subject to much greater agitation and movement than are terrestrial soils. Wave action causes beach sands to move along shorelines (a process called littoral drift). Winter storms also mix and wash sands away, thereby diluting arsenic into very low concentrations.

Third, the tugs are not expected to cause significant amounts of sediment disturbance. The tugs would be positioned in deep water, with propeller wash directed either parallel to or away from the shoreline and, in many cases, tugs would be located on the seaward side of the barge. They would not stir up significant amounts of sediment (see Chapter 6).

With all of these considerations, arsenic risks to endangered fish or other marine life would not change significantly due to barging.

10.3.5.2 Alternatives 1 and 2

Propeller wash would not cause arsenic-related impacts on endangered fish species or other marine life for the same reasons stated for the Proposed Action.

10.3.5.3 No-Action

Under No-Action, barging would not occur. There would be no concerns regarding arsenic and propeller wash.

10.4 Adverse Impacts and Mitigation

10.4.1 Significance Criteria

King County considers the following to be indicators of significance for environmental health and safety impacts under SEPA:

- posing long-term risks to human health or the environment, such as storage, handling, or disposal of toxic or hazardous material; or

- violating the Model Toxic Control Act or other laws aimed at handling and storage of hazardous waste.

10.4.2 Measures Already Proposed by the Applicant or Required by Regulation

a. **Cleanup Action Plan.** At the request of King County, the Applicant has prepared a draft soils management plan to allow public and agency review and comment on proposed measures (included as Appendix C in the DEIS). Following public and agency review of the draft soils management plan, King County will require the Applicant to prepare a final Cleanup Action Plan (CAP). The plan shall be accepted and approved by King County prior to issuance of a permit for mining above current levels at the site.

The draft management plan (Appendix C of the DEIS) proposes to contain contaminated soils in a lined and covered containment cell located on the north side of the property. No topsoils would be removed from the site. The containment cell would be built in phases (Figure 10-3). At full capacity (when mining is complete), the berm would measure up to 30 feet high and 2,100 feet long. The berm would have clean soil placed on top of it, and it would be vegetated. As recommended in Chapter 5, revegetation with native species would be preferred.

Over the course of mining at the site, about 271,000 cubic yards of material containing arsenic above residential cleanup levels (as defined under the MTCA, Method A) would be excavated and contained. Of this total volume, approximately 50,520 cubic yards would contain arsenic concentrations that are also above industrial cleanup levels (again, using MTCA Method A). Soils containing arsenic concentrations above industrial cleanup levels would be managed in a separate phase of the cell.

The containment cell would be provided with an impermeable bottom liner. The bottom liner would be placed above a leveling pad of native sand. Prior to placing the arsenic-impacted oils, a layer of sand would be placed above the liner to protect it from damage during subsequent fill placement.

A single-layer geosynthetic clay liner is proposed. GCLs are made with a layer of refined clay, with permeabilities in the range 1×10^{-8} to 1×10^{-9} cm per second, bound between layers of geotextile. A GCL is considered equivalent to 2 to 4 feet of clay with a permeability of 1×10^{-7} cm per second. The clay in GCLs swells when exposed to water and this swelling action closes possible openings in the liner.

To protect the GCL liner from damage during installation and construction, a layer of bedding sand 6 inches thick would be placed over the subgrade to protect the liner from puncture by the gravelly soil. The bedding sand would be screened to remove all material with a diameter greater than 0.5 inch.

The GCL would then be covered with a 6-inch layer of drain sand. The drain sand should consist of material with 100 percent of grain sizes finer than 0.5 inch, and less than 3 percent of grains finer than the U.S. No. 200 sieve (0.003 inch).

A 6-inch diameter perforated pipe would be installed along the north (downslope) side of the cell. This drain would lead to a manhole on one end of the cell. This drain would serve to prevent build-up of water over the liner and to provide sampling access. A 2-inch diameter perforated pipe would be installed in the bedding sand (under the liner) along the north side. This would also lead to a manhole on one end of the cell and could be used to monitor water under the liner.

The contaminated soil would be placed over the drain sand in horizontal layers and compacted. The purpose of placement and compaction is to provide a stable slope and firm support for the final cover. Trees and brush would be removed from contaminated areas prior to excavation of contaminated soil.

The Applicant proposes a single-layer synthetic membrane or GCL for the cover, to be installed above the contaminated soil. The cover would provide the same barrier to infiltration as the liner. The base for the cover would be screened soil with 100 percent of grain sizes finer than 0.5 inch. The base sand could be contaminated soil originating onsite that has been screened. The flexible membrane would be covered with a geotextile fabric to protect it from damage.

The cover would be covered with a 6-inch layer of screened drain sand or synthetic drain layer, with the same specifications as the sand placed over the bottom liner. The drain layer would be covered with 18 inches of soil, and the surface would be vegetated. Topsoil would not be required as long as the cover soil had sufficient nutrients to support a healthy vegetation cover. Vegetation is needed to prevent surface erosion and for aesthetic purposes.

The containment cell would be constructed in steps to match the mine operation. The first step would start at the downslope (north) end, to collect rainwater infiltration and potential leachate. The first step is expected to accommodate soil from Phase 1 and 2 of the mine operation (or about 46,000 cubic yards of contaminated soil). During soil placement, temporary berms would be constructed upslope to prevent rainfall runoff from entering the cells. Some rainfall would seep into the sand drain layer over the bottom liner during soil placement. This water would drain into the perforated pipe on the downslope side.

Any water collected from the berm would be tested and handled according to procedures outlined in the MTCA. Soils placed in the containment cell would not generate significant leachate. Leachate could occur during construction of the berm prior to placement of the top liner. This leachate would consist of precipitation that fell directly on the soils and infiltrated the stockpiled soils. Thus leachate would be expected to occur only during the initial construction of each cell of the containment berm. If leachate continued to collect, it would be a sign that the cover had been compromised and the liner would then need to be repaired.

b. **Air Emission Control Methods.** Air emission control methods would be implemented during all excavation and cleanup activities that have the potential to generate air pollutants. These methods include the use of controlled excavation methods, wetting, material covering, housekeeping, and use of covered trucks.

c. **Dust Monitoring Plan.** The Applicant has proposed to monitor ambient air quality on the property perimeter during cleanup activities at the site. The ambient air-monitoring plan would describe the basis of design for the monitoring program; general program procedures; air sampling procedures; meteorological monitoring procedures; laboratory methods; and reference standards.

The objectives of the air-monitoring plan would be to:

1. monitor ambient air quality for potential pollutants related to onsite activities;

2. quantify potential offsite transport of project-related emissions; and

3. assess the effectiveness of onsite emission control methods used during excavation and cleanup activities.

As part of the monitoring program, a “wind rose” would be generated based on annual data obtained from the closest meteorological station. (A wind rose is a graph showing the frequency and strength of wind from various directions in a given area.) The results of this wind rose would be used to establish the location of air quality sampling stations at the site.

As a conservative assessment of particulate matter (dust) emissions, sampling would be conducted for total suspended particulate (TSP) for comparison to the PM10 action level (see Chapter 3 for discussion of PM10). PM10 is only a portion of the TSP, so a measurement for TSP always includes a greater range of particulate matter than would a PM10 measurement.

Lead, cadmium, and arsenic concentrations will also be assessed by collection of particulate matter on TSP filters.

Air quality action levels would be used as an indicator of the effectiveness of onsite emission control methods used during excavation and cleanup activities. In the event that single data point concentrations exceeded action limit criteria, a contingency plan detailing additional control measures would be implemented. Action levels for the potential air pollutants monitored would be established in conjunction with the Puget Sound Clean Air Agency, the King County Health Department, and the Washington State Department of Ecology.

d. **Worker Safety.** Workers onsite must have sufficient training and safety equipment to control their potential exposure to soil contaminants during site clearing and restoration. Exposure monitoring must be done during topsoil management to determine if the action level is reached or exceeded. If the action level of 5 µg per m^3 (averaged over an 8-hour period) is exceeded, additional engineering controls and worker protection would be required as mandated by state law. The additional measures could consist of workers wearing respiratory protection or using water to reduce dust generation.

10.4.3 Remaining Adverse Impacts and Additional Measures

10.4.3.1 Health Impact 1

Specific Adverse Environmental Impact. During excavation and movement of contaminated soils, airborne dust containing arsenic and other metals could leave the site and potentially pose a public health hazard.

10.4.3.2 Health Mitigation 1

The following measures would reduce risks associated with arsenic leaving the site as dust during soil extraction and containment procedures:

a. Contaminated soils should be cleared and collected in manageable phases.

b. Contaminated soils should be covered while being temporarily stockpiled or transported to the containment cell. Soils should be transported by covered truck, rather than by conveyor or open-bed truck.

c. Temporary covers should be placed over contaminated material within containment cells prior to final sealing of the cell.

Regulatory/Policy Basis for Condition. Title 10 of the Code of the King County Board of Health specifies a number of requirements for solid waste management. The topsoils with elevated levels of metals are classified as a problem waste (10.08.345). The King County Solid Waste Regulations provide some exemptions for landfills that contain problem wastes, however, other provisions of the regulations apply.

Section 10.28.120 defines the authority for the health officer to regulate excavated soils as solid waste if the material contains significant levels of contamination above that specified by the MTCA (WAC 173-340).

Section 10.28.010 describes the requirements for storage of solid waste until it is removed to a disposal site. The disposal site in this case would be the permanent lined containment system that is planned for the site. This section requires that materials shall be contained to prevent blowing. The use of temporary, durable plastic sheeting can be used for temporary stockpiles that will accumulate prior to the placement of the final cover over the accumulated waste in the containment cell.

The Puget Sound clean air regulations, Section 9.11, specify the requirements for emission of contaminants. This section states "It shall be unlawful for any person to cause or allow the emission of any air containment in sufficient quantities and of such characteristics and duration as is or is likely to be, injurious to human health, plant or animal life or property, or which unreasonably interferes with enjoyment of life and property." Section 9.15 specifies the requirements for fugitive dust control. The requirements include the need to use enclosures and wet suppression techniques, as practical, and curtailment during high winds.

10.4.3.3 Health Impact 2

Specific Adverse Environmental Impact. Arsenic in soils within the containment cells could be mobilized in the event the bottom liner or cover fails.

10.4.3.4 Health Mitigation 2

The following measures related to the soil containment system should be considered to reduce the possibility for leachate or subsurface flow through or within the containment cell, as recommended by the Department of Ecology (2000):

a. A "linear low-density polyethylene" geo-membrane should be used to line and cover the cell instead of bentonite clay. This would minimize potential leakage and improve constructability.

b. Additional sand should be used in the cell liner and cover.

c. A berm with a height of 3 feet or greater should be constructed at the toe of the cell to provide sufficient freeboard to contain the maximum allowed accumulation of leachate, which is 2 feet.

d. The slope angles and drainage properties of the cover system should be designed carefully to ensure that it does not fail, causing offsite erosion.

e. The site grading plan should be revised to eliminate the direct-runoff pathway to Puget Sound at the cell's east end.

Regulatory/Policy Basis for Condition. Title 10 of the Code of the King County Board of Health spells out requirements for solid waste management. The bottom liner should be constructed with at least 2 feet of recompacted clay with a permeability of no more than 1 X 10 $^{-6}$ cm per second and sloped no less than 2 percent (10.36.050 B. 2). The use of an equivalent design is allowed, provided the liner is at least as effective as the liners required in the regulation (10.36.050 A and B). The Ecology review (Ecology 2000) summarizes the issue of using the GCL liner with regard to constructability. The Applicant would need to submit adequate information to the County to justify the design of the bottom liner.

Section 10.36.050 also spells out the requirement for the cover of the containment cell. The standard design requires that the liner be constructed with at least 4 feet of recompacted clay or other material with a permeability of no more than 1 X 10^{-7} cm per second or a synthetic liner of at least 50 mils in thickness. Again, the use of alternative designs requires County review.

Section 10.36.040 requires the installation of a leachate control system sized according to water balance calculations or using other accepted engineering methods either of which shall be approved by the Health officer. Paragraph B states that the leachate control system shall be designed to prevent no more than 2 feet of leachate from developing in the low point of the active area.

10.4.3.5 Health Impact 3

Specific Adverse Environmental Impact. Placement of the containment cell in the northern edge of the property may result in instability of the sea bluff due to the extra weight along the top of a sensitive slope. In addition, normal erosion and retreat of the top of the slope could undermine the containment cell causing an uncontrolled release of soil with elevated concentrations of metals.

10.4.3.6 Health Mitigation 3

Final placement of the containment cell should be chosen to minimize adverse effects based on the final design specifications for the mine. The location and final placement of the cell should be specified in the CAP.

Regulatory/Policy Basis for Condition. Chapter 21A.24 of the King County Code outlines requirements related to development in environmentally sensitive areas. The eastern portion of the site contains a wave-eroded bluff with a height in excess of 300 feet. Shallow instabilities have occurred in the past and will occur in the future due to undercutting of the toe by wave erosion. Chapter 21A.24.280 A requires a minimum buffer of 50 feet from all landslide hazard areas. The buffer shall be extended as required to mitigate a steep slope or erosion hazard or as otherwise necessary to protect the public health, safety, and welfare.

10.4.3.7 Health Impact 4

Specific Adverse Environmental Impact. Placement of an impermeable liner and cover above and below the containment cell could trap methane gas that would be generated naturally from organic matter in the soil.

10.4.3.8 Health Mitigation 4

A provision for collection and venting of the gases would be needed. Generation of methane gas would take place over a period of a few years. It is unlikely that sufficient gas would be generated to support a flare. Installation of a methane-collection system in the containment cell would allow for the collection and proper venting of the methane gas. No offsite migration of methane gas to adjacent structures would be expected. Any venting of methane gas would require a permit from the Puget Sound Clean Air Agency.

Regulatory/Policy Basis for Condition. Title 10 of the Code of the King County Board of Health outlines requirements for solid waste management. Chapter 10.76 contains requirements for the control and monitoring of methane. These requirements apply to all landfills with the exception of inert waste landfills.

10.5 Cumulative Impacts

Since site soils can be managed to avoid significant impacts, the Proposed Action and alternatives would not result in cumulative impacts to environmental health and human safety.

10.6 Significant Unavoidable Adverse Impacts

None expected. The CAP would be consistent with the MTCA, and the MTCA has established action levels to protect human health and the environment. Based on the evidence presented in this EIS, and on the feasibility of known containment methods, the project would not result in a significant adverse risk to human health due to arsenic contamination or other health concerns.

10.7 Citations

10.7.1 Printed References

AESI. See “Associated Earth Sciences, Inc.”

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Table 10-1. Analytical Test Results for Surface Soil Samples on the Glacier Northwest Site (ppm)[a]

Sample Number[b]	Site Type[c]	Surface			9-Inch Depth			18-Inch Depth		
		Arsenic	Cadmium	Lead	Arsenic	Cadmium	Lead	Arsenic	Cadmium	Lead
1[d]	F	**330***	2	830	37	0.84	27	43	0.66	19
2	F	120	2.3	390	25	1.2	10	8.7	0.56U	5.6U
3	F	150	0.79U[e]	280	110	0.91	81	10	0.62	8.6
4	F	160	1.5	450	19	0.72	25	4.2	0.53U	5.3U
5	F?	47	0.92	54	47	0.84	59	43	0.63U	51
6	F	100	9.3	470	**270***	2.9	120	64	1.1	30
7	F?	17	0.58U	13	19	0.56U	18	13	0.53U	11
8	F	190	3	550	67	0.94	41	10	0.58U	7.6
9	F	98	1.6	510	110	0.95	30	9.2	0.77	7.1
10	GP	4.3	0.53U	5.3U	1.6U	0.53U	5.3U	1.6U	0.52U	5.2U
11	GP	1.9	0.53U	5.3U	1.6U	0.55U	5.5U	1.6U	0.53U	5.3U
12	F?	6.1	0.54U	5.8	6.2	0.54U	5.4U	5.7	0.55U	6
13	F	**220***	1.2U	470	130	0.82	45	8.2	1.5	8.3
14	F	18	0.91	70	130	1.2	37	2.0U	0.92	36
15	GP	1.6U	0.53U	5.3U	1.6U	0.53U	5.3U	1.6U	0.53U	5.3U
16[d]	F	**280***	1.6	730	39	0.84	17	40	0.89	23
17	F	61	6	240	**260***	1.2	35	11	0.52U	5.2U
18	GP	11	0.59U	7.1	8.2	0.57U	5.7U	5.9	0.57U	6.1
19	F	100	6	470	**270***	1.4	67	3.8	0.59U	5.9U
20	F	140	5.4	710	11	0.59U	11	7.6	0.59	6.6
MTCA[f]		200	10	1,000	200	10	1,000	200	10	1,000
MTCA[g]		20	2.0	250	20	2.0	250	20	2.0	250

Note: This table replaces Table 3 of Appendix C for the DEIS, which contained typographical errors. All analyses in both the DEIS and the FEIS are/were based on the correct data presented here.

* Exceeds MTCA Method A cleanup values for industrial sites.

[a] All units are parts per million (ppm), milligrams/kilogram.

[b] Sample numbers correspond to Terra Associate sample locations shown on Figure 10-1.

[c] Site Type: F is forested area; F? is forested area but has signs of recent grading or disturbance; GP is in the area of the existing gravel pit.

[d] Sample No. 16 is a field replicate of Sample No. 1

[e] U indicates that the metal was not detected at the stated detection limit.

[f] MTCA Method A cleanup values for industrial sites.

[g] MTCA Method A cleanup values for residential sites.

Source: Terra Associates, Appendix B of the DEIS.

Table 10-2. Analytical Test Results for Sand and Gravel Samples on Glacier Northwest Site (ppm)[a]

Sample Designation[b]	Sample Location	Arsenic	Cadmium	Lead
EP-15 @ 9	Exploration Pit EP-15, 9 feet below ground surface, sample of sand beneath surficial till soils.	4.3	0.58U[c]	5.8U
EP-16 @ 10	Exploration Pit EP-16, 10 feet below ground surface, sample of sand beneath surficial till soils.	4.5	0.54U	5.4U
EP-17 @ 8.5	Exploration Pit EP-17, 8.5 feet below ground surface, sample of sand beneath surficial till soils.	2.7	0.61U	6.1U
EP-18 @ 10	Exploration Pit EP-18, 10 feet below ground surface, sample of sand beneath surficial till soils.	2.4	0.53U	5.3U
EP-19 @ 10	Exploration Pit EP-19, 10 feet below ground surface, sample of sand beneath surficial till soils.	3.9	0.54U	5.4U
EP-20 @ 10	Exploration Pit EP-20, 10 feet below ground surface, sample of sand beneath surficial till soils.	2.4	0.54U	5.4U
EP-21 @ 10	Exploration Pit EP-21, 10 feet below ground surface, sample of sand beneath surficial till soils.	3.5	0.54U	5.4U
EP-22 @ 10	Exploration Pit EP-22, 10 feet below ground surface, sample of sand beneath surficial till soils.	3.1	0.54U	5.4U
EP-23 @ 10	Exploration Pit EP-23, 10 feet below ground surface, sample of sand beneath surficial till soils.	4.6	0.54U	5.4U
EP-24 @ 10	Exploration Pit EP-24, 10 feet below ground surface, sample of sand beneath surficial till soils.	6.9	0.58U	5.8U
EP-25 @ 10	Exploration Pit EP-25, 10 feet below ground surface, sample of sand beneath surficial till soils.	3.1	0.54U	5.4U
EP-26 @ 10	Exploration Pit EP-26, 10 feet below ground surface, sample of sand beneath surficial till soils.	3.3	0.54U	5.4U
EP-27 @ 10	Exploration Pit EP-27, 10 feet below ground surface, sample of sand beneath surficial till soils.	4.0	0.56U	5.6U
EP-28 @ 10	Exploration Pit EP-28, 10 feet below ground surface, sample of sand beneath surficial till soils.	2.2	0.52U	5.2U
G-1	Grab sample from existing vertical cut into native sands.	1.6U	0.53U	5.3U
G-2	Grab sample from existing vertical cut into native sands.	2.2	0.53U	5.3U
G-3	Grab sample from existing vertical cut into native sands.	1.6	0.53U	5.3U
G-4	Grab sample from existing vertical cut into native sands.	1.8	0.54U	5.4U
OBW-6 @ 95	Observation Well OBW-6, approximately 95 feet below ground surface, sample of sand.	1.9U	0.63U	6.3U
OBW-7 @ 270	Observation Well OBW-7, approximately 220 feet below ground surface, sample of sand.	2.4	0.67U	6.7U

Table 10-2. Continued

		Arsenic	*Cadmium*	*Lead*
	Median	3.1	n/a	n/a
	Mean	3.27	n/a	n/a
	Standard Deviation	1.29	n/a	n/a
	Puget Sound Background[d]	7	1	24
	MTCA industrial cleanup value[e]	200	10.0	1,000
	MTCA residential cleanup value[f]	20	2.0	250

[a] All units are mg/kg, parts per million (ppm).

[b] Sample locations are shown in Figure 10-2.

[c] U indicates that the analyte was not detected at the stated detection limit.

[d] 90th percentile levels from Ecology Publication #94-115, *Natural Background Soil Metals Concentrations in Washington State.*

[e] MTCA Method A cleanup values for industrial sites.

[f] MTCA Method A cleanup values for residential sites.

Source: Terra Associates, Appendix B of the DEIS.